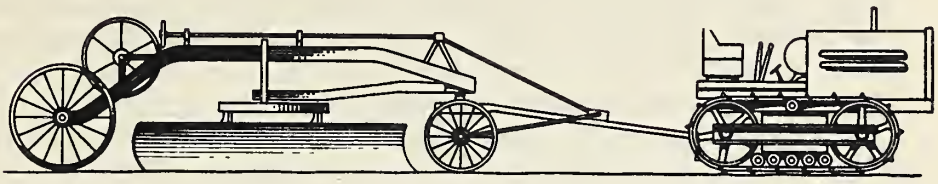
CONSTRUCTION



HINTS

UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE
WASHINGTON, D.C.

Volume 7 September 1941 Number 5

The material appearing on page 2 of this issue, relative to the sustitution of other metals for aluminum as ordinarily used for engine governors and pistons, is quoted from a circular letter forwarded to all Regions. It is repeated in Construction Hints to permit wider circulation.

Voltage Regulators, appearing in this issue, was contributed by Mr. Oscar Wiederhold, Division of Engineering, Chief's Office.

E. S. MASSIE, Jr.
Editor

Due to the shortage of aluminum, engine governors with cast iron bodies will soon be furnished on Forest Service contracts. The present stainless steel governor parts may be replaced by parts made of cold rolled steel. If such governors are offered or received they should be accepted providing they are supplied from any of the three manufacturers whose products are now approved. These are Handy, Monarch, and Hoof. No difficulties are anticipated from the use of these materials provided frequent and thorough cleaning of the working parts of such governors is carried out. This will require removal, cleaning, and lightly oiling all the working parts at least once every 3 months irrespective of whether such a governor has been in continuous use. Failure to carry out this recommendation is certain to result in the difficulties formerly experienced in the sticking of the governor working parts which was the basic reason for requiring aluminum and stainless steel.

The Office of Production Management advises that aluminum for engine pistons is not available. No difficulties from a change to cast iron or steel pistons should be expected except that ungoverned engines should preferably be operated at 10 to 20 percent slower speeds to prevent any possibility of premature connecting-rod bearing failures or excess vibration. Where changeover is made to cast iron or steel pistons, clearances should be figured on the time-tested policy of allowing .001" clearance per inch of piston diameter with a possible reduction of 20% of this amount for engines operating continuously on part throttle and an increase of 20% for engines operating continuously under nearly full load.

VOLTAGE REGULATORS

Practically all trucks and most tractors now being purchased for Forest Service use are equipped with vibrating type regulators for controlling generator charging rate.

These regulators have been supplied in two types, One type includes a combination generator cutout and voltage regulator and is used on the 1939 Dodge (see figure 1). The other type consists of a combination cutout, voltage regulator, and current regulator, and is used on the 1940 Dodge, Ford, and most tractors. The type furnished with the 1940 Dodge trucks is shown in figure 2, for the 1940 Fords in figure 3, and for the 1941 Chevrolets in figure 4.

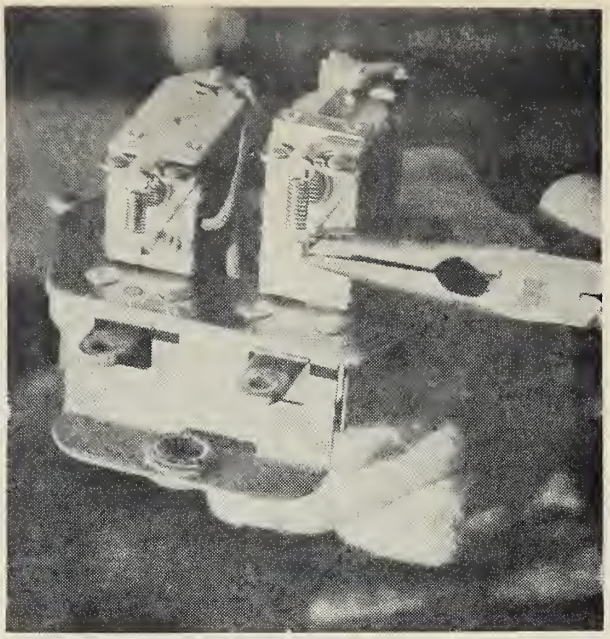
Various difficulties may develop with these regulators, particularly as regards improper setting of the voltage output. This defect has resulted in the burning out of regulators, generators, ignition breaker points, etc.

In connection with the adjustment of regulator settings it should be pointed out initially that these adjustments cannot be made, even roughly, without the use of an accurate reading voltmeter. This is due to the fact that the range between the proper and improper setting may be not more than 4/10 of a volt. Various types and makes of testing instruments are available and are made by the Weston Instrument Company, Newark, N. J., Burton Rogers Company (Hoyt Instruments), 857 Boylston Avenue, Boston, Mass., and others.

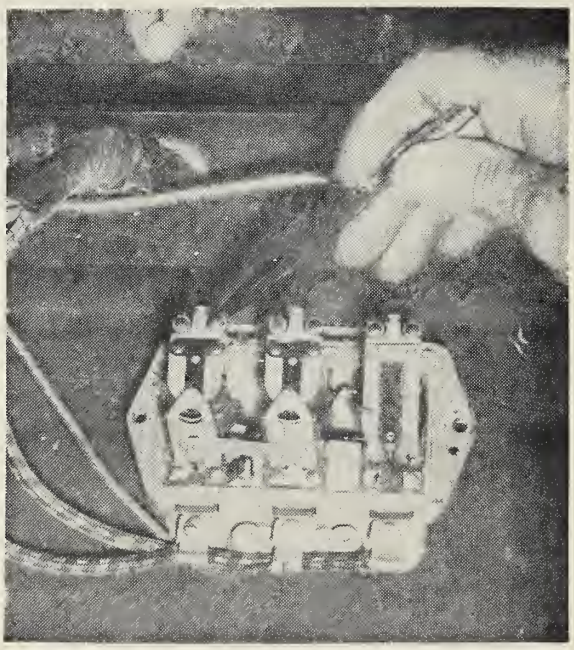
The writer uses a Triplett Model 666 portable meter with a separate 50 ampere external shunt. (See figure 5). This meter sells for approximately $25.00 list, including a leather carrying case. Government discount of 50 percent applies. While this meter has been designed for radio service it has an advantage over some of the instruments designed especially for regulator testing in that it includes an ohmmeter by which the resistances of regulator coils, etc., can be checked. The Triplett Electrical Instrument Company is located at Bluffton, Ohio.

The Triplett instrument does not include the variable resistor circuit found on most standard regulator tester sets. This resistor is recommended by regulator manufacturers for making certain tests but can be eliminated under some conditions. This will be described further on.

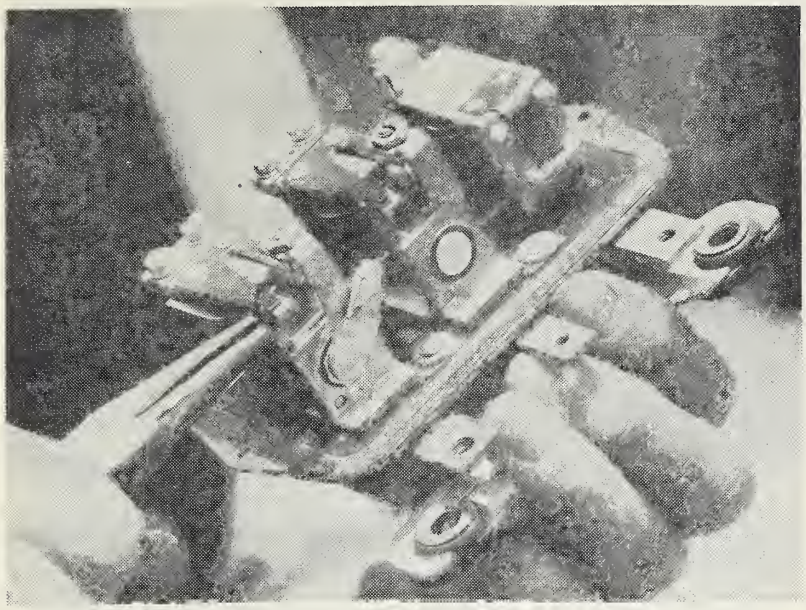
While instruments are absolutely essential in making regulator adjustments it frequently happens that the camp mechanic is required to determine whether or not difficulties lie in generator or regulator. To accomplish this there are one or two simple tests that can readily be performed, the results from which are fairly reliable.



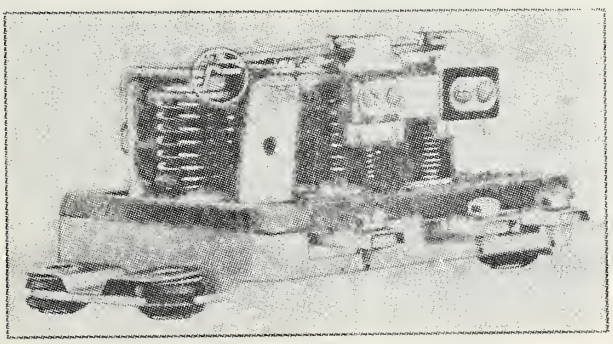
Adjusting voltage regulator in the 1939 Dodge 2-unit regulator box. The voltage regulator in the 3-unit box (1940 Dodge) is adjusted similarly. Cover should be in place before taking final meter reading. Fig. 1.



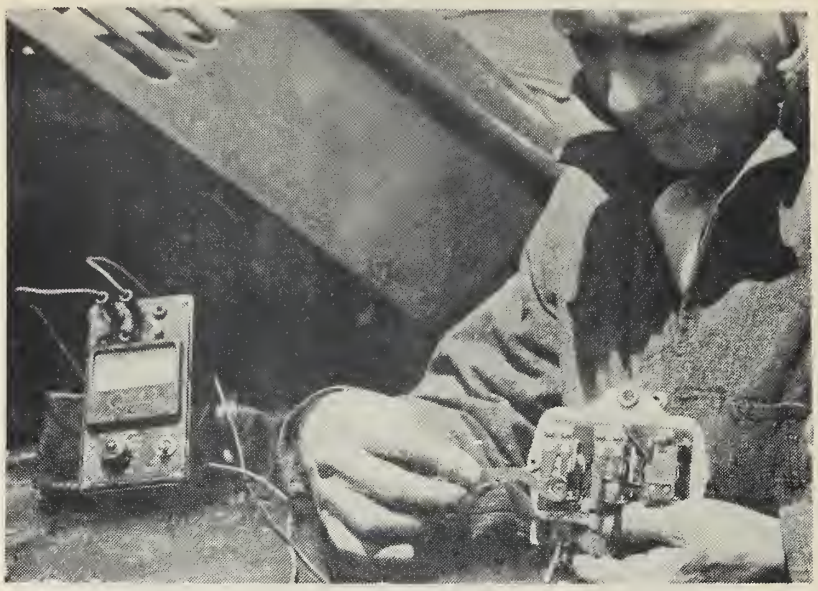
Three-unit regulator used on the 1940 Dodge. Pencil points to the voltage regulator which is adjusted in the same manner shown in Fig. 1. The center unit is the current regulator and is adjusted the same as the voltage regulator. Fig. 2.



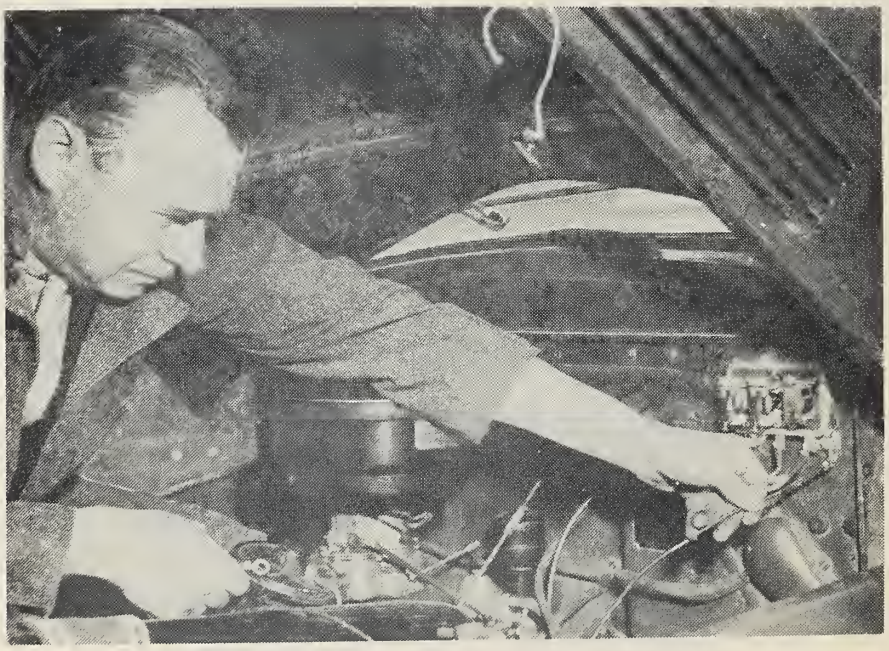
Close-up of Ford voltage regulator voltage adjustment. The center regulator is the current regulator and is adjusted in the same manner. The unit on the right is the generator cutout. Fig. 3.



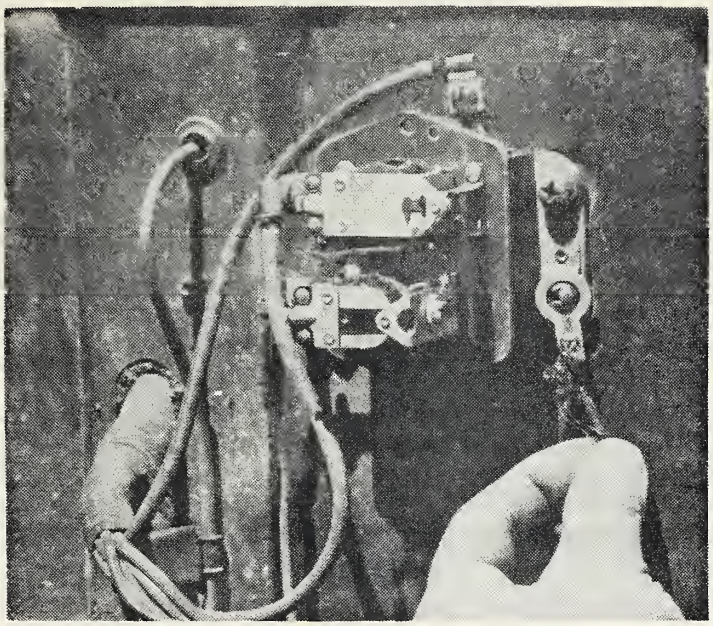
View of voltage regulator furnished on 1941 Chevrolets. Fig. 4.



How not to adjust Ford regulators for voltage. The procedure shown here is for adjusting the armature gap and should only be made when installing new points or cleaning the old ones. Fig. 5.



All regulator boxes should be permanently grounded to the generator by attaching a wire direct from regulator attaching screw to generator frame bolt. In this illustration the generator has been removed from its support to better illustrate the location of the ground wire connection. Fig. 6.



Attaching ground wire to Dodge regulator. Other end of wire should be attached to one of the frame screws on the generator. It is important that ground wire terminals at the generator should not touch either one of the two live generator terminals. Fig. 7.

Regulator Type	Used on Truck	Ohms Resistance Voltage Red.	Ohms Resistance Coil	Armature Gap	Contact Point Gap	Voltage Setting and Recommended Generator R.P.M.	Current Regulator Setting
V.R.P. 4002-B	1939-Dodge	10.4 to 11.2		.0595" to .0625"	.010" to .020"	7.5	None
V.R.P. 4001-A	1940-Dodge	6.5 to 7.5		.048" to .052"	.012" Min.	7.5	34
Three unit	Ford	13 to 14				7.5	30

1. Ammeter shows zero with engine running. This difficulty can be isolated in regulator or generator on the Dodges or 1941 Chevrolets by momentarily connecting the generator field terminal to the ground with wire or screwdriver. The field terminal can be identified by the letter "F" or the word "Field" stamped on the generator directly alongside this terminal. Also, the wire leading from the field terminal is always of the smaller size. If on grounding this terminal with engine running about one-half governed speed, the ammeter indicates a charge, difficulties can be expected in the regulator. If the grounding still produces no charging indicating on the ammeter the defect can usually be expected to lie in the generator. The Ford regulator may be tested in the same manner except that the field terminal should not be grounded but should be connected to the other generator terminal by wire, pliers, or other means. It should of course be remembered that the basic purpose of the voltage regulator is to reduce the generator charging rate when the battery becomes fully charged. The regulator should not be condemned therefor until the test outlined in the next paragraph (2) has been made.

2. Low reading on the ammeter. If the voltage regulator is properly operating, the charging current will gradually drop as the battery becomes fully charged. This is due to the battery voltage rising and opposing the voltage of the generator. To check the operation of the regulator, permit the starter to crank the engine with ignition switch off for 5 or 10 seconds. By cranking the engine, the voltage decreases as a result of the battery being partially discharged. The engine should then be started and this lowered voltage should immediately permit the generator charging rate to increase, as indicated by the dash ammeter, if the regulator is functioning correctly. If this reading jumps up to 20 or 25 amperes the regulator can be assumed to be properly operating. Whenever a battery is found to be reading approximately 12.50 or lower and the ammeter will not read over 10 amperes at any engine speed, difficulties in regulator or generator can usually be expected.

The foregoing test cannot be made on the Fords due to the absence of a dash ammeter. The Ford meter is actually a voltmeter and its use has certain advantages when operated with voltage regulated systems. Checks of these meters show some variation in accuracy but in general a needle reading in the green portion indicates approximately 7.5 volts. This is approximately the correct maximum generator output. Needle readings in the left hand red portion indicate too low a generator setting or a run-down battery and needle readings in the right hand red portion indicate too high a generator regulator setting. The regulator should never be adjusted by the reading of the dash voltmeter.

When checking regulators with instruments the exact procedure is described in the various manufacturer's instruction books. Reference should also be made to pages 145 to 169 in "C.C.C. AUTO MECHANICS", a copy of which is available in all camps, and to the Chevrolet 1941 Shop Manual.

While each particular make of regulator has certain individual characteristics, in general the major adjustments are made in the same manner on most all types and makes. This consists of increasing or decreasing the regulator spring tension as shown in figures 1 and 3. Adjustments to the Ford regulator armature gap as shown in figure 5 should not be made unless new points are being installed. Changing the setting at this point is almost certain to result in erratic charging and arching at the regulator points unless these are carefully dressed after adjusting. When regulators are encountered that appear difficult to adjust it is always advisable to check the resistance of the voltage regulator operating coil. The resistances of these coils are given in the accompanying table.

It will be noticed that most manufacturers recommend testing of voltage regulators at certain definite engine speeds. This is because regulators used on most small trucks and passenger cars do not have sufficient capacity to handle the entire generator field current, irrespective of speed, as do the regulators used on the larger trucks, buses, etc. In the latter type the battery may be entirely disconnected and the voltage regulator will maintain a substantially constant generator voltage irrespective of engine (and generator) speed. This type was used on some of the C.C.C. heavy duty F.W.D. semitrailers and dump trucks.

It is possible for field inspectors to set the regulators without checking generator speed by installing a fully charged battery and setting the regulator not to exceed 7.5 volts (measured at the generator) and with the battery connected. The battery cells should read not less than 12.75 gravity and show a voltage of not less than 7 volts while being charged at approximately 10 amperes. After all, the fully charged battery represents desired ultimate conditions and in this condition the regulator should come into action and automatically reduce the charging rate.

Most manufacturers recommend the use of a variable or fixed resistor as a load for the generator when testing regulators. The Ford Company recommends that the battery be entirely disconnected and a special 3/4 ohm resistor be connected from generator to ground. This serves as a standard load by which definite setting recommendations can be made by the factory. Dodge and Chevrolet recommend a variable resistor be connected in series with the generator and battery so that the generator load may be increased or decreased.

It is possible to obtain a satisfactory regulator adjustment without the use of the resistor by merely disconnecting the battery wire at the regulator and adjusting the regulator to 7.2 volts (measured at the generator) and at an engine speed not to exceed approximately 1,000 r.p.m. This is approximately one-half the Ford, Dodge, and Chevrolet (1-1/2 ton stake and dump trucks only) governed speed. This method is recommended only for field inspectors and while entirely satisfactory results can be obtained a certain amount of experience is required before the method can be used as a regular procedure.

Current Regulator

The three unit Ford, Dodge, and Chevrolet regulators include a current regulator in addition to the voltage control. The current regulator serves only to limit the amount of current (amperes) produced by the generator. It thus serves as a protecting device to prevent damage to the generator from overcharging as might be the case should the battery be run down and its voltage materially drop. This regulator does not come into operation until the maximum current output of the generator is approached. To test the regulator an ammeter is essential. By holding the voltage regulator points in contact and speeding up the engine, the current regulator should limit the current to the maximum hot output as recommended by the manufacturer. (30 amperes is the case of Dodge, Ford, and Chevrolet 1-1/2 ton trucks). This test must of course be made with the battery connected.

Adjustments to the current regulator are made in the same way as to the voltage regulator. The current regulator is the center unit in both the Dodge and Ford 3-unit boxes and the right hand unit in the 1941 Chevrolet box, looking towards the front of the box as mounted on the truck.

Ground Wire

All late type regulators are equipped with ground wires that run from regulator body to generator frame. This wire eliminates difficulties that might arise due to poor ground connections at cab, frame, generator, etc. Most of the Ford and Dodge trucks received during 1939 and 1940 were not equipped with this wire and it is recommended that it be installed at the earliest opportunity. The proper procedure for the Ford is shown in figure 6. Similar procedure should be followed with the Dodges as shown in figure 7. The 1941 Chevrolets have not yet been received and it is not known whether or not such a wire will be provided.

Regulator Cover

In making adjustments to regulators the covers should always be held in place before taking voltmeter readings. This is because different readings will be obtained with and without the cover in place since the cover forms part of the regulator magnetic circuit when in place. It is also advisable to first warm up regulators by operating the engine 5 or 10 minutes before making any adjustments since most regulators are compensated for temperature changes. If this were not the case the generator voltage would increase excessively as the temperature increased. It is also important that batteries always be installed with the proper terminal grounded since failure to do so may result in a burned up regulator. This is because many regulator points will give satisfactory service only if the current travels across the gap in one particular direction. Reversing the battery connections reverses the direction of current.

Relationship between Charging Rate and Battery Condition

In general it might be mentioned that where regulators appear to be properly operating as indicated by the dash ammeter or by voltage tests, cleaning or adjustment of the points should not be made. Likewise it should also be remembered that where a voltage regulator is properly operating the generator charging rate (amperes) is controlled almost entirely by the battery voltage and in turn, of course, the condition of battery charge. When the battery voltage a and condition is high the generator charging rate, as indicated by the ammeter, should automatically decrease to 5 or 6 amperes or less. Where the battery condition and voltage is low the generator charging rate should automatically increase to 25 or 30 amperes or to the setting of the current regulator. Since the difference in voltage between a fully charged battery and one partially discharged is not more than 1 or 1.2 volts, the absolute importance of using only accurate and sensitive meters when adjusting regulators can be appreciated.

Modern Types

While regulators used on most Forest Service and CCC equipment are of the simple 2 or 3 unit types, some of the modern heavy duty trucks and buses use regulators of more or less complicated appearance. Basically, however, the purpose of the voltage regulator is to increase or decrease the generator field current so that the generator maintains a constant voltage output irrespective of generator speed.

Some Delco regulators employ extra windings in addition to the regulator operating winding (the latter always connected across the generator brushes) to increase the speed of the point movement (and therefore reduce the arcing) or to compensate for temperature changes.

On some of the late type heavy duty air conditioned buses regulators having as many as five units are employed in order to handle the heavy generator currents involved.

Voltage regulators are by no means modern devices having been used in various forms as far back as 1914 or earlier; the old Packard Bijur system being a good example.

The major difficulty with regulators, however, has always been and still is the contact points. These should be kept clean and properly aligned and when operating satisfactorily should be left alone. Covers should always be kept tightly in place so as to exclude all dust and dirt.